Were the measurements standardized sufficiently in published studies about mean platelet volume?

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Recently, several studies about mean platelet volume (MPV) changes in various pathological conditions were published. The aim of this study was to evaluate the accuracy of the measurement in these studies. The study was performed using the data of 181 studies containing a healthy control groups within 1181 studies about MPV indexed PubMed database since 2012. A total of 81 studies were included retrospectively. The distributions of sex, age, and platelet counts were not reported in 16, 12, and 28 studies, respectively. Type of anticoagulant was not noted in 60 studies. The technology used was not specified in 36 studies. The MPV values measured with Sysmex were significantly higher than measured with Beckman Coulter, Abbott CELL-DYN, and Siemens ADVIA. The MPV measurements varied up to 17.8% by the instruments. The measurement times between 15 min and 2 h was significantly different from the measurement times less than 15 min and more than 2 h. The MPV measurement times from venipuncture were not indicated in 86 studies (47.5%). Maximum deviations in MPV measurements by the MPV measurement times and plus the instruments used varied up to 17.8 and 27.7%, respectively. Both the MPV measurement times and instruments used were not stated in 29 studies (16.0%). Only 47 prospective studies (26.0%) enlightened about the type of anticoagulant, instruments used for MPV measurement, MPV measurement time, platelet counts, and MPV values. As a result, the measurements were not standardized sufficiently in published studies about MPV. It may be explained that the differences between the results of studies made the same pathological conditions. *Blood Coagul Fibrinolysis* 28:234–236

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Introduction

Modern automated hematology analyzers report routinely the different platelet parameters. Mean platelet volume (MPV) like mean corpuscular volume associated with red cells is a parameter expressed the mean volume of circulating platelets as femtoliters. Recently, MPV aroused the interest of researchers, and several studies about MPV changes in various pathological conditions were published. The aim of this study was to evaluate the measurement accuracy in these investigations.

Methods

The study was performed using the data of 181 studies containing a healthy control group within 1181 studies about MPV indexed on PubMed database since 2012.

All results are expressed as the mean ± SD. An alpha level of 0.05 was considered statistically significant. Unpaired Student's *t*-test (independent unequal sample sizes) was used for the comparisons of the means of platelet values by sex of the controls in various age groups, the MPV values measured with different technologies and MPV measurement times from venipuncture. Statistical analysis was done with Microsoft Excel 2007 software (Microsoft Corporation, Redmond, Washington, USA).

Results

A total of 81 studies (44.7%) were included retrospectively. Healthy control groups included 80.52 ± 70.51 individuals (mean ± SD; 20–582). The distributions of sex, age, and platelet counts were not reported in 16 (8.8%), 12 (6.6%), and 28 (15.5%) studies, respectively. The means of platelet counts by sex of the controls in various age groups are in Table 1. The sex and age groups were not differ significantly by the means of platelet counts ($r = -0.40$; $P > 0.05$).

EDTA, low concentrate (1 : 9), and high concentrate (1 : 4) citrate were used as an anticoagulant in 112, seven, and two studies, respectively, and the type of anticoagulant was not noted in 60 studies (33.1%). There was no study to compare the difference of anticoagulants.

The instruments of Beckman Coulter (Beckman Coulter Inc., Fullerton, California, USA), Sysmex (Sysmex Corporation, Kobe, Japan), Abbott CELL-DYN (Abbott Laboratories, Abbott Park Road, Illinois, USA), Siemens ADVIA (Siemens Healthcare GmbH, Erlangen, Germany), Mindray BC-6800 (Shenzhen Mindray Bio-Medical Electronics Co, Ltd, Nanshan, Shenzhen, China), HORIBA ABX Micros 60 (HORIBA Medical, Grabels, France), and Diatron Abacus Junior B (Diatron

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Table 1 The means of platelet values by sex of the controls in various age groups

Group	*n*	Male control	Female control	Mean of platelet values	
				Male	Female
Children	20	735	640	293.44×10^9/l	295.20×10^9/l
Adults	105	3838	4261	252.99×10^9/l	258.30×10^9/l
Older adults	12	613	671	236.74×10^9/l	241.14×10^9/l
All	137	5186	5572	256.80×10^9/l	260.47×10^9/l

n, number of studies.

Messtechnik GesmbH, Wien, Austria) were used for the measurements of MPV in 53, 46, 32, nine, two, two, and one studies, respectively, and the technology used in automated blood cell counting was not specified in 36 studies (19.9%). The comparison of the MPV values measured with different technologies is in Table 2. The MPV values measured with Sysmex were significantly higher than the MPV values measured with Beckman Coulter, Abbott CELL-DYN, and Siemens ADVIA. The MPV measurements varied up to 17.8% by the instruments.

The MPV measurement times from venipuncture in studies are shown in Table 3. The measurement times between 15 min and 2 h were significantly different from the measurement times shorter than 15 min and longer than 2 h. The MPV measurement times from venipuncture were not indicated in 86 studies (47.5%). The MPV measurements by the MPV measurement times and plus the instruments used varied up to 12.5 and 27.7%, respectively. Both the MPV measurement times and instruments used were not stated in 29 studies (16.0%). Only 47 prospective studies (26.0%) enlightened about the type of anticoagulant, the instruments used for MPV measurement, MPV measurement time, platelet counts, and MPV values.

Discussion

Preanalytic variability like choice of anticoagulant and measurement time after venipuncture, etc. cannot be ignored because these factors affects the results considerably [1–5]. Therefore, the studies related with MPV should be performed prospectively. Nearly half of the evaluated researches about MPV were performed retrospectively in this study.

Correct measurement of MPV was associated with the anticoagulant used in complete blood count. Jackson and Carter [6] reviewed the effects of anticoagulants in blood counting. The increment of MPV induced by exposure to EDTA is dependent on the measurement time from venipuncture. Maximal changes occur within the first 2 h after venipuncture, but a progressive increase in MPV continues for a longer time. This increment generally occurs up to 30% within first 5 min of exposure to EDTA and then increases by another 10–15% over the subsequent 2 h [6]. Lancé *et al.* [7] performed a study which was aimed to standardize the effects of anticoagulants and the measurement time on measurement of MPV. The investigators reported that the optimal measurement time after venipuncture was 120 min with EDTA and 60 min with citrate [7]. It seems that the timing is very important for measurement of MPV. Despite the usage of EDTA is often, low and high concentrations of citrate is used rarely as an anticoagulant in the evaluated studies, and the type of anticoagulant was not noted in one-third of studies. There was no study to compare with the effects of different anticoagulants. In the evaluation of the MPV measurement times from venipuncture in studies, the measurement times between 15 min and 2 h was significantly different from the measurement times of shorter than 15 min and longer than 2 h. The MPV measurement times from venipuncture were not indicated in almost half of the studies. The MPV measurements by the MPV measurement times varied up to 12.5% in these studies and this difference was notified as 2–50% by the review of Jackson and Carter [6].

Table 2 The comparisons of the mean platelet volume values measured with different technologies

	n	MPV (mean ± SD)	Sysmex	Abbott CELL-DYN	Siemens ADVIA
Beckman Coulter	53	8.24 ± 0.73	$P = 1.51 \times 10^{-9}$	$P = 0.525$	$P = 0.237$
Sysmex	46	9.45 ± 1.00	–	$P = 5.67 \times 10^{-8}$	$P = 1.91 \times 10^{-7}$
Abbott CELL-DYN	32	8.11 ± 0.92	NA	–	$P = 0.667$
Siemens ADVIA	9	8.02 ± 0.44	NA	NA	–

MPV, mean platelet volume; *n*, number of studies; NA, not applicable.

Table 3 The comparisons of mean platelet volume measurement times from venipuncture

Group	Measurement time	*n*	MPV (mean ± SD)	B	C	D	E
A	≤15 min	8	8.14 ± 0.55	$P = 0.008$	$P = 0.365$	$P = 0.126$	$P = 0.001$
B	>15 to ≤30 min	29	8.95 ± 1.05	–	$P = 0.012$	$P = 0.292$	$P = 0.373$
C	>30 to ≤60 min	38	8.36 ± 0.71	NA	–	$P = 0.308$	$P = 0.001$
D	>1 to ≤2 h	16	8.63 ± 0.93	NA	NA	–	$P = 0.058$
E	>2 h	4	9.16 ± 0.25	NA	NA	NA	–

MPV, mean platelet volume; *n*, number of studies; NA, not applicable.

The various techniques of different instruments for measuring the complete blood count lead to variable MPV results, too [3–5]. MPV discrepancies up to 40% were reported with comparison of the instruments [2,8–10]. The mostly used instruments of the measurements of MPV in evaluated studies were Beckman Coulter, Sysmex, Abbott CELL-DYN, and Siemens ADVIA. In addition, the technology used for automated blood cell counting was not specified in 19.9% studies. The MPV values measured with Sysmex were significantly higher in comparisons with the MPV values measured with Beckman Coulter, Abbott CELL-DYN, and Siemens ADVIA. The MPV measurements varied up to 17.8% by the instruments and maximum deviation together with the difference of instruments used plus MPV measurement times was up to 27.7%.

As a result, the measurements were not standardized sufficiently in published studies about MPV. It may explain the differences between the results of studies made same pathological conditions. It is important that studies which are planning prospectively about MPV must provide the standardization anticoagulant type, measurement technology, and the measurement time after venipuncture because of data accuracy and reliability.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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